Logistics Reduction: Universal Waste Management System (LR-UWMS)

Completed Technology Project (2014 - 2022)

Project Introduction

The objective of the Advanced Exploration Systems (AES) Logistics Reduction (LR) project's Universal Waste Management System (UWMS) task is to develop a compact toilet system that can be used across multiple future crewed vehicles and habitats. The UWMS effort will result in a toilet with reduced mass and volume that provides increased crew comfort and performance. A key feature of the UWMS is the urine pretreatment dose pump/pretreatment quality indication device which enables water recovery from urine. The UWMS core hardware is primarily funded by the AES LR project, with cost sharing from the Orion (MultiPurpose Crew Vehicle (MPCV)) Program for a second flight unit, and the ISS Program for ISS-unique hardware and integration hardware for flying the first UWMS unit on ISS.

Procurement of the UWMS started late in 2015. UWMS Integration and ISS planning began in 2015 and continued through 2021 in collaboration with the ISS Payloads Office and the Orion Program.

The UWMS will first serve as an ISS technology demonstration (TD) payload. After the initial AES TD period, the UWMS will remain on ISS for an extended demonstration until the end of ISS life. The extended demonstration supports increased ISS crew size once US commercial crew vehicles are operational.

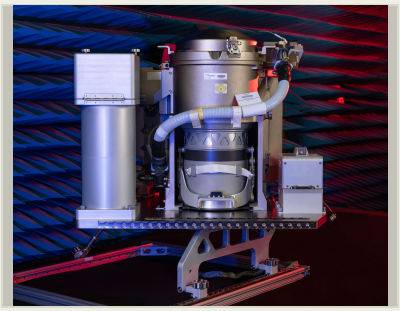
The ISS UWMS demonstration will validate the hygienic collection of urine and feces. Effective collection is critical to maintain crew health and hygiene for long-duration habitats. Additionally, the ISS TD will demonstrate the ability to pretreat urine and deliver it to the ISS urine processor. The pretreat pump and pretreat quality sensor are important components of a future long-term space habitat water recovery system. A second UWMS unit will be developed to fly on the MPCV Artemis-2 mission.

The project to develop and build two UWMS units is nearing completion. In FY20, the UWMS Unit 1 (ISS) was delivered to NASA-JSC and launched on NG-14 for installation in ISS Node 3. It is currently awaiting completion of installation and checkout. The unit will then begin long duration on-orbit TD operational testing. The completion of these on-orbit performance milestones will represent the final stage of the UWMS baseline contract. Fecal canisters will be returned from ISS for evaluation of compaction efficiency and consumables use to inform future exploration missions. The AES TD then transitions to a three-year ISS TD.

In December 2019, the UWMS Unit 2 (Orion) was delivered to KSC and was installed into the Artemis-2 vehicle in March, 2021. Launch schedule for Artemis-2 is currently in 2024.

[1:50 PM] Ewert, Michael K. (JSC-EC211)

The waste management team collaborates with the SBIR program on new technologies related to fecal stabilization and resource recovery, including torrefaction, membrane drying, and ultrasonic drying of feces. Additionally,



UWMS with Integration Hardware for use on ISS

Table of Contents

Logistics Reduction: Universal Waste Management System (LR-UWMS)

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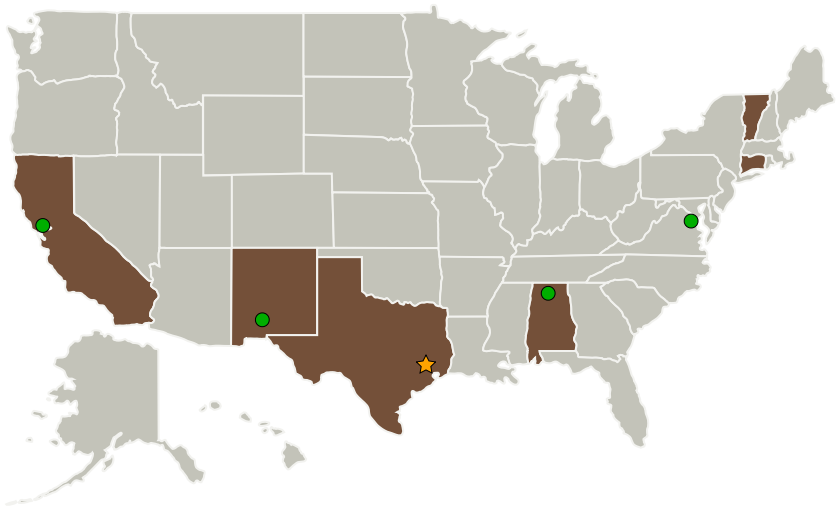
the UWMS team collaborates with the MPCV's Launch, Entry, and Abort (LEA) space suit team for contingency urine and fecal waste collection systems. The LEA suit waste collection system is used if the MPCV loses cabin pressure, but it may be possible to use the LEA contingency system to provide a backup for waste collection if the UWMS became inoperable.

Anticipated Benefits

The toilet system has a lower mass and volume than prior systems, is simpler to use, provides increased crew comfort and performance, and treats urine so that it can be safety processed by the spacecraft recycling systems. Future exploration vehicles being developed by NASA will have smaller habitable volumes than the ISS. As habitable volumes decrease, so should toilet hardware so that crew comfort can be preserved. Having a universal, or standardized toilet design that can be adapted for multiple vehicles reduces overall costs. UWMS consumables and replacement hardware could also be used by multiple vehicles, reducing overall integrated mission logistics complexity. The UWMS effort could eventually lead to development of low mass/volume fecal canisters, increasing packaging and stowage efficiency, which significantly reduces logistics for exploration metabolic waste collection. The fecal canisters could be designed to enable water recovery from feces, which further reduces logistical mass and volume.

The UWMS could be utilized on short- and long-duration NASA missions to provide a compact toilet and urine pretreatment dose pump/pretreatment quality indication device to enable water recovery.

Primary U.S. Work Locations and Key Partners



Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Exploration Capabilities

Project Management

Program Director:

Christopher L Moore

Project Manager:

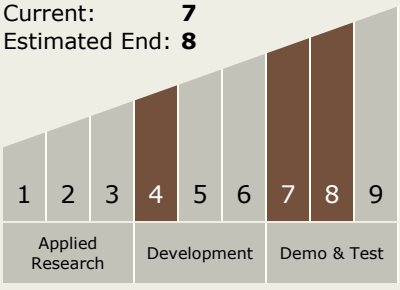
Melissa K Mckinley

Principal Investigator:

Melissa K Mckinley

Technology Maturity (TRL)

Start: **4**
Current: **7**
Estimated End: **8**



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Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
●Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
●Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
●NASA Headquarters(HQ)	Supporting Organization	NASA Center	Washington, District of Columbia
●White Sands Test Facility(WSTF)	Supporting Organization	NASA Facility	Las Cruces, New Mexico

Co-Funding Partners	Type	Location
Advanced Fuel Research, Inc.	Industry	East Hartford, Connecticut
Hamilton Sundstrand Space Systems International Inc	Industry	

Primary U.S. Work Locations	
Alabama	California
Connecticut	District of Columbia
New Mexico	Texas
Vermont	

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.1 Environmental Control & Life Support Systems (ECLSS) and Habitation Systems
    - TX06.1.3 Waste Management

Target Destinations

Earth, The Moon, Mars

Supported Mission Type

Planned Mission (Pull)

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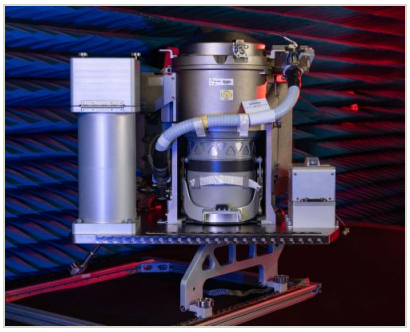
Images



UWMS ISS Unit with Integration Hardware
UWMS with Integration Hardware for use on ISS
(https://techport.nasa.gov/image/143377)

UWMS volumetic mockup with urine storage tanks.
UWMS volumetic mockup with urine storage tanks.
(https://techport.nasa.gov/image/143376)

Project Website:

https://oasis.jsc.nasa.gov/projects/advdev/Logistics/SitePages/Home.aspx